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*Mopalia hindsi recurvans*, subsp. nov. (Amphineura)

by

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(Plate 6)

In the course of an ecological study of the chitons of San Francisco Bay during February, 1952, to June, 1953, about 400 specimens of the genus *Mopalia* were collected and examined. Of that number 280 were *Mopalia hindsi* (Reeve, 1846). All specimens were measured, the gut contents examined and identified where possible, and the gonads were microscopically examined by a smear to determine maturity of ova or sperm; in addition, a microscopic examination of the bristles covering the girdle was made for each specimen.

It was discovered that 28 of the specimens of *Mopalia hindsi* had bristles which were characteristically different from the bristles described by LeLoup (1942) for *M. hindsi*. Upon closer examination, the 28 specimens were found to differ in the texture of the sculpturing of the valves as well as in color from typical specimens of *M. h. hindsi*.

The 28 specimens were also found to differ ecologically from *Mopalia h. hindsi*. These 28

specimens were found in the same areas as *M. h. hindsi* but were relatively plentiful at only 3 locations; these areas are located near the mouth of San Francisco Bay (see Table I). Typical *M. h. hindsi* were plentiful at all localities where the diverse forms were found. An analysis of the gut contents revealed that although the new form takes in about the same proportions of animal to plant material as typical *M. h. hindsi*, they ingest different kinds of animal material (Barnawell, 1960).

On the basis of these differences, it seems clear that a new subspecies has been discovered. It is my belief that it does not deserve specific rank because: (1) the distributional patterns of *Mopalia h. hindsi* and *Mopalia hindsi recurvans* are completely overlapping; (2) although there appears to be evidence that the two are using different foods, their food habits are very similar; (3) no completely sexually mature specimens of *Mopalia hindsi recurvans* were found.

Table 1

Station	North Latitude	West Longitude	Number of Specimens Found	Date Collected
San Francisco Aquatic Park	37°48'24-36"	122°25'24-30"	8	July 20, 1952; November 30, 1952; December 29, 1952; May 12, 1953; July 10, 1960.
Southwest Sausalito	37°51'06"	122°28'36"	9	July 9, 1952; July 21, 1952; April 5, 1953.
West Angel Island	37°51'30"	122°26'33"	1	April 18, 1953.
Tiburon	37°52'21"	122°27'00"	7	December 28, 1952; May 13, 1953; July 10, 1960.
Belvedere	37°52'06"	122°28'00"	2	December 14, 1952.
Yerba Buena Island	37°48'24-54"	122°21'00-42"	2	August 7, 1952.
End Richmond Breakwater	37°54'18"	122°23'12-24"	1	May 3, 1953.
Castro Rocks	37°55'54"	122°25'12"	1	April 16, 1953.

Mopalia hindsii recurvans Barnawell,
subspec. nov.

DESCRIPTION

The holotype is a partly mature male, eroded, anterior valve with eight low, rib-like elevations terminating in slits at the insertion in the girdle, the valve otherwise smooth and lacking sculpturing. The mid-valves with a single low, rib-like elevation extending from the beak of the valve anteriorly and diagonally to the slit at the insertions of the valve into the girdle. The lateral areas of the mid-valves possess low, smooth, minute projections which are scattered regularly over the surface grading from almost no projections to a series of low, smooth projections which run together to form a series of smooth, low ridges perpendicular to each other, producing a basket weave pattern.

The color of the valves is rust brown (Munsell R2.5 3/4) with olive green (Munsell G7.5 6/4) maculations which roughly parallel the growth lines. Color was determined by comparison with the Munsell Book of Color. Internally, the first mid-valve has a faint rust-colored (Munsell R7.5 8/4) flame radiating diffusely out from the beak.

The girdle is relatively narrow and clothed with a uniform scattering of soft amber bristles. The proximal third of the bristles is decorated with chitinous spines on the dorsal surface which are inserted in sockets in a fashion similar to the quill of a feather. The spines are strongly curved back through their terminal half so that they almost always point toward the base of the bristle. The tip of each chitinous spine is in turn provided with a calcareous spine inserted in a V-shaped socket. The calcareous spines are frequently lost so that often only the V-shaped socket remains.

Table 2

Specimen	Sex	Measurements (in millimeters)		Collected (see Table 1)	Date
		Length	Width		
Holotype	male	53	38	San Francisco Aquatic Park	July 10, 1960.
Paratype 1	immature	31	21	Tiburon	July 10, 1960.
Paratype 2	immature	38	28	San Francisco Aquatic Park	July 10, 1960.
Paratype 3	female	50	36	San Francisco Aquatic Park	December 29, 1952.
Paratype 4	female	30	20	Tiburon	May 13, 1953.

DESCRIPTION OF PARATYPES

(See Table II for measurements, sex, locality, and collecting dates.)

Paratype #1: Sculpture of valves more discrete with ribs on anterior valve outlined by a series of low, rounded projections. The posterior edge as well as the sutural line of each mid-valve are delineated by low, rounded projections. Coloration is more vividly green and brown than the holotype, with a series of chevron-shaped white markings on the mid-valves with the open end of the chevron pointing anteriorly (see Plate 6, fig. 2).

Paratype #2: Like paratype #1 in coloration and sculpture but lacking the chevron-shaped white markings (see Plate 6, fig. 3).

Paratype #3: Sculpture like that of holotype; color of valves predominantly olive green (Munsell G7.5 6/4) with maculations of rust-brown (Munsell YR2.5 3/4). Girdle is pinkish brown (Munsell YR2.5 8/4) and light in color. Specimen partly eroded.

Paratype #4: Eroded specimen like paratype #3 except the coloration of the girdle is dark brown and valves have larger blotches of rust-brown color (Munsell YR2.5 3/4) on a predominantly olive-green background. The second valve is almost entirely rust-brown. Anterior valve is covered by a bryozoan.

LOCALITY

Holotype from San Francisco Aquatic Park north of the Sea Scout Pier in the rocky intertidal area; 37°48'24"-36" N.; 122°25'24"-30" W. Other localities are shown in Table I.

DEPOSITION OF TYPES

Holotype USNM Cat. No. 613,139; Paratype #1 USNM Cat. No. 613,140; Paratype #2 California Academy of Sciences Type No. 12,141; Paratype #3 California Academy of Sciences Type No. 12,142; Paratype #4 British Museum (Natural History) No. 19,601,276.

DISCUSSION

The chitinous bristles which cover the girdle form the most prominent characteristic separating Mopalia hindsii recurvans from M. h. hindsii. In M. h. recurvans the bristles are soft and amber-yellow (Munsell YR10 7/10), very like those of M. h. hindsii in texture. The dorsal side of the bristles is decorated with the recurving chitinous spines usually over the proximal one third. The bristles of M. h. hindsii, although distributed similarly, are more flattened and the chitinous spines are more delicate and usually inserted only on the proximal fourth of the bristles; further, they show no tendency to recurve. The chitinous spines on the bristles bear calcareous spines on their tips which appear very similar to the ones in

the subspecies.

The valves are different in two respects from those of *Mopalia h. hindsii* — sculpture and coloration. Berry (1922) has described the sculpturing on the median valves of *M. hindsii* between the anterior granose rib and the posterior sutural thickening as "showing an interwoven basket-like pattern of varying distinctness". In *M. h. recurvans* the basket-like pattern is much less distinct and near the margins may be completely lacking.

The slits in the valves are identical to *Mopalia h. hindsii*, having eight in the head valve, one on each side of the median valves, and one on each side of the tail valve with an angular posterior sinus in the articulamentum.

In color there are some distinctive differences between *Mopalia h. hindsii* and *M. h. recurvans*. *M. h. recurvans* is mottled on the tegmentum with green and rust-brown flames which may appear striped parallel with the growth lines. The color of the tegmentum in *M. h. hindsii* is usually more dull. The interior of the median valves of *M. h. recurvans* usually has a distinct, large, pink (Munsell R5 7/8) flame which spreads from the beak both laterally and posteriorly. In *M. h. hindsii* the pink flame is confined almost entirely anteriorly to the sutural line. In the subspecies as in *M. h. hindsii* there exist some individuals with white markings on the valves as illustrated in Plate 6, fig. 2.

The radulae of members of the genus *Mopalia* differ from one another only in the relative size and massiveness of the teeth and do not provide an adequate basis for differentiation. The radulae of *M. h. hindsii* and *M. h. recurvans* appear identical.

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Explanation of Plate 6

- Figure 1: *Mopalia hindsii hindsii* (REEVE, 1846). 38 mm. long, 30 mm. wide. Figure 2: *Mopalia hindsii recurvans* BARNAWELL, subsp. nov., Paratype 1; color variant; 31 mm. long, 21 mm. wide. Figure 3: *Mopalia hindsii recurvans* BARNAWELL, subsp. nov.; Paratype 2; 38 mm. long, 28 mm. wide. Figure 4: Typical bristles from the girdle of *Mopalia hindsii hindsii* (REEVE, 1846). Figure 5: A single bristle from the girdle of *Mopalia hindsii recurvans* BARNAWELL, subsp. nov., Paratype 3. Figure 6: A row of bristles from the peripheral edge of a young (20 mm. long, 15 mm. wide) specimen of *Mopalia hindsii recurvans* BARNAWELL, subsp. nov. Collected at Sausalito, May 5, 1953. Figure 7: A single bristle from the same specimen showing attachment of the chitinous spines to the larger bristle and the calcareous tip on one spine to the right.

(Note: the photomicrographs, figures 4 to 7 inclusive, were taken by the author with phase contrast)